Attachment 1

Technical Description

Network

The proposed terminals will operate in the same ViaSat Exede Ka-band network as residential customers using the fixed VSAT equipment authorized under call sign E100143 and aeronautical mobile customers using terminals authorized under call sign E120075. Building upon its experience with Ku-band based AMSS and ESV mobile broadband, ViaSat has incorporated the functions necessary to support mobility into the management functions of the Exede network. The network allows the aircraft to fly across the service area and seamlessly switch from spot beam to spot beam within the current operational satellite and to switch between satellites as coverage dictates.

Generally, when within the coverage footprint of ViaSat-1, the terminals will operate using ViaSat-1 spot beams to take advantage of its higher power and G/T and thereby enjoy improved throughput. As the aircraft flies across areas not supported by ViaSat-1, the AES will switch to capacity on the WildBlue-1 or Anik-F2 spacecraft.

The network is managed using time division multiple access ("TDMA") techniques. Because the Exede architecture employs adaptive coding and modulation, the terminals could transmit at any code and modulation point within the library of available choices. The available symbol rates are 625,000 symbols per second, or kilobaud (kBd), 1.25 MBd, 2.5 MBd, 5 MBd, and 10 MBd. The maximum clear sky e.i.r.p. density in Form 312 uses the 625 kBd rate. However, the 625 kBd symbol rate is used primarily for network ranging and login. Service traffic typically uses the 1.25 MBd or higher symbol rates. While the service may be operational while on the ground, in general operation will be while the aircraft is in flight and above most rain attenuation.

The Exede architecture is designed to always operate at the lowest power density modulation and code point that allows the link to close. The network employs active power control and reduces power when conditions permit, keeping the Es/No margin at 1 dB or less. When the modem has sufficient excess transmit capability, it will automatically switch to the next point in the library of modulation, FEC, and symbol rate choices and increase data rate, keeping the e.i.r.p. density at the minimum. This further reduces the likelihood that the system will impact traffic on other satellites.

The control point for all terminals will be ViaSat's network operations center (NOC) located at 5970 South Greenwood Plaza Blv, Suite 300, Greenwood Village, Colorado 80111, and can be contacted 24/7 at (720) 554-7575. This single point of contact will have the capability of shutting down any of the terminals operated within the network. The terminals will be capable of operating with each of ViaSat's Ka-band gateway hubs that communicate with the ViaSat-1, WildBlue-1 and Anik-F2 satellites. The specific hub terminal used at any point in time will depend on the geographic location of the terminal and the satellite being used to provide service.

Antenna and Pointing Accuracy

The antenna used in this application is a low profile waveguide horn array. The Mantarry M32 is a mechanically steered waveguide horn array antenna. The M32 designation reflects the number of feed horns across the width of the aperture. The M32 shown in Figure 1 is 32 horns wide and provides a smaller radome footprint than the currently authorized M40 antenna. The height of the M32 array is 15.75 cm and the width is 63 cm.

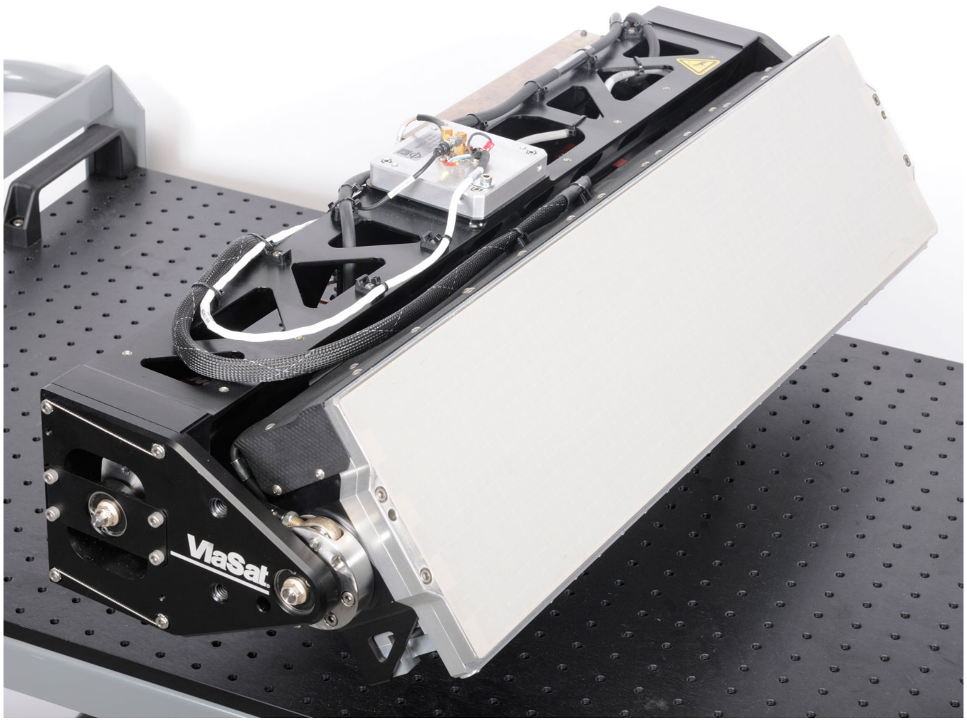

Figure 1 – Mantarry M32 Front View

These antennas have two transmit receive interface adapters (TRIA), one for each polarization. The TRIAs are similar in design to the outdoor units used on ViaSat's current blanket licensed fixed earth station (call sign E100143), but modified for airborne use and with slightly higher output power. The TRIA feeds a passive feed network which divides and routes the power to each of the feed horns in the array.

The Mantarry antenna will be fuselage mounted typically as depicted in Figure 2 and will be covered by a radome.[1]

The terminal is directed toward the intended satellite by the antenna control unit (ACU), which receives input data from the inertial reference unit (IRU) that is part of the avionics navigation system of the aircraft. This input includes information, such as the current

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[1] The same radome may also house a receive-only antenna for DBS satellite TV services. The DBS satellite receive-only antenna and service are not associated with, or part of, this application.

latitude, longitude, altitude, pitch, roll and yaw. The antenna control unit uses this information to calculate the initial pointing angles and polarization for the antenna to the desired satellite (ViaSat-1, WildBlue-1, or Anik-F2). Once the required pointing angles have been determined, the ACU will drive the antenna to the desired position and the modem will attempt to acquire the receive signal from the satellite. When the signal is received and the modem is able to properly identify and demodulate the carrier, the antenna will enter a closed loop tracking mode.

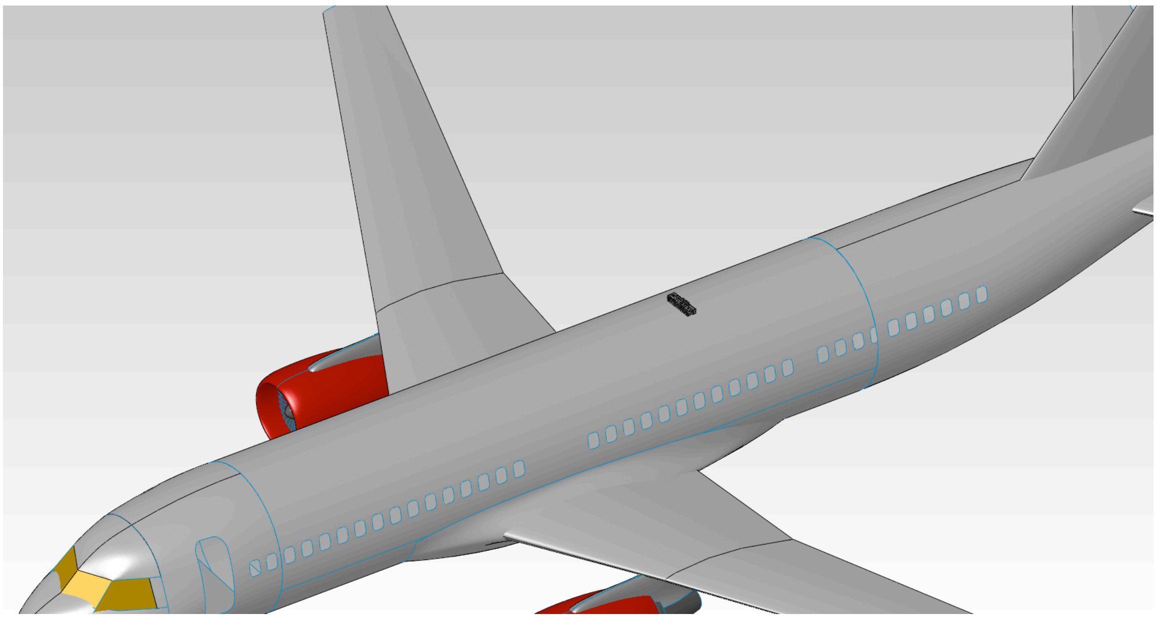

Figure 2 – Typical Antenna Mounting Location

By performing closed loop tracking, the ACU is able to properly account for any installation alignment differences between the IRU / airframe and antenna, as well as bending of the aircraft body on the ground or in flight. The antenna system also incorporates local rate gyros to mitigate latency between the IRU and the Mantarry ACU and further improve pointing accuracy.

The mean pointing error is 0° in both the azimuth and elevation directions and the standard deviation (σ) for each axis is given in Table 3 along with the peak pointing error (3σ or 99.73%). The pointing error values are different in the azimuth and elevation directions because the arrays are wider than they are tall. The M32 has a 4:1 width to height aspect ratio and accordingly the elevation beamwidth is wider than the azimuth beamwidth by the same factor. Likewise, the target standard deviation for pointing accuracy follows the same ratio.

The antenna control unit monitors the current and target pointing directions and if the error limit in either the azimuth or elevation axis is exceeded, the transmit output from the modem is inhibited in less than 100 ms (20 ms typical). The pointing error inhibit threshold is programmable for each axis, and ViaSat proposes to inhibit transmissions should the pointing error exceed 0.5° in the azimuth direction, or 1.0° in the elevation direction. The measured 1σ and 3σ pointing error versus the transmit inhibit limits are provided in Table 3 below.

	1σ		3σ		Limit	
	Azimuth	Elevation	Azimuth	Elevation	Azimuth	Elevation
M40	±0.097°	±0.221°	±0.291°	±0.663°	±0.5°	±1.0°

Table 3 – Pointing Error

ViaSat's coordination with other satellite operators assumed worst-case antenna pointing and geographic skew conditions, taking into account the maximum possible off-axis EIRP power spectral density levels under those conditions.

Antenna Patterns

The antenna patterns generated by the M32 antenna are similar to those of the currently-authorized M40 antenna. The patterns are characterized by a narrow main beam and a line of sidelobes in the azimuth axis, a wide main beam and line of sidelobes in the elevation axis, and relatively low amplitude sidelobes elsewhere. Figure 3 depicts an X-Y view of the azimuth and elevation patterns when looking directly into the boresight of the antenna. The figure illustrates the lobes that exceed the Section 25.138 limit.

Notably, there are four grating lobes in the transmit antenna patterns that are well removed from the main lobe. These grating lobes are only present for a limited range of skew angles centered around approximately 25º of skew. The location and amplitude of the grating lobes is a function of transmit frequency and typically are between 25 and 35 degrees off axis from the main lobe. A 25-degree skew cut pattern showing the magnitude of these grating lobes is also included as Exhibit C. While the amplitude of these grating lobes when operating at the highest clear sky e.i.r.p. is as much as 22 dB above the 25.138 off-axis e.i.r.p. density mask, the location of these lobes with respect to the geostationary satellite orbital (GSO) arc is such that the lobes do not intersect the GSO arc except when the aircraft is located in a limited number of geographic areas. ViaSat has analyzed the potential impact to the spacecraft at the affected locations and found the actual level of interference to be minimal – less than 2% delta T/T at the lowest symbol rate of 625 kBd and only 0.2% at the 5 MBd symbol rate.

Figure 3 depicts the grating lobes as viewed looking into the boresight of the antenna. The three black lines represent the GSO arc from the perspective of the terminal at three different geographic locations: Carlsbad, CA, Melbourne, FL, and Germantown, MD.

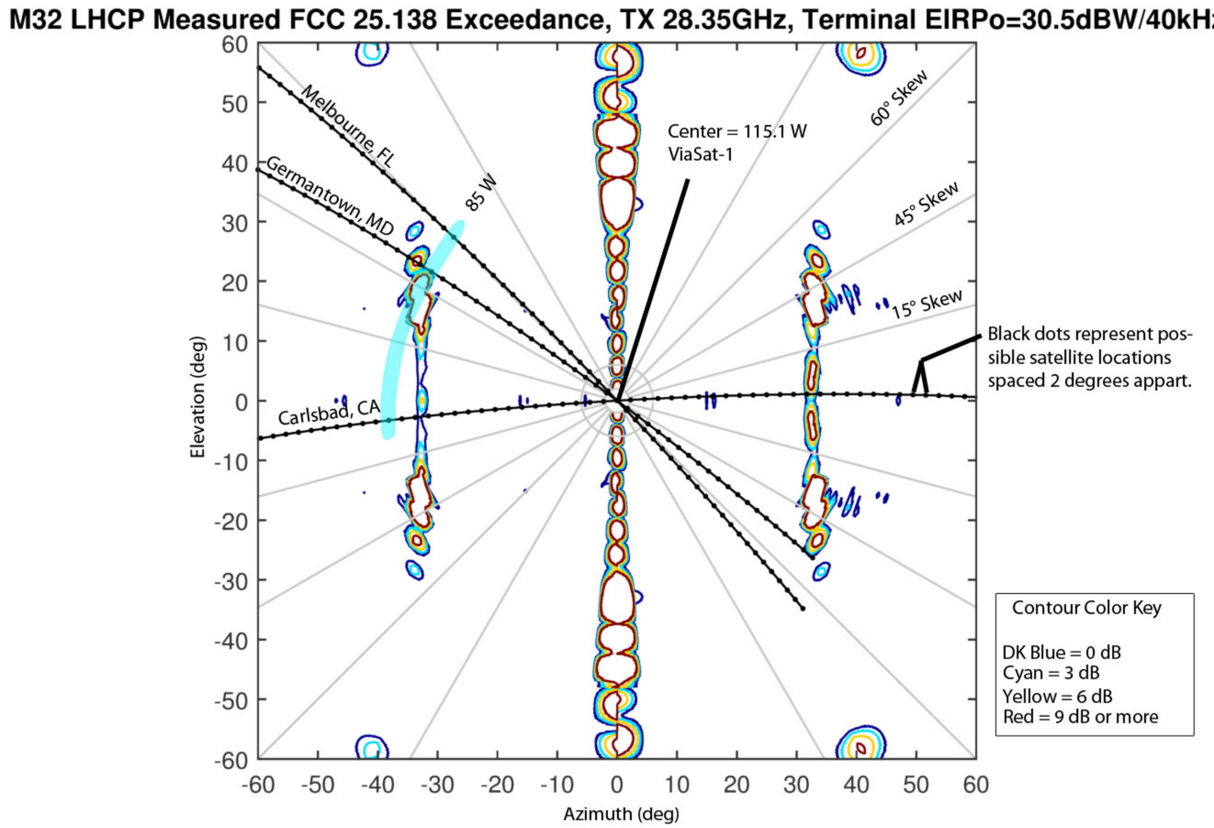

Figure 3

The potentially affected satellite is SES AMC-16 at 85º WL and is 26 and 30 degrees away for WildBlue-1/Anik-F2 and ViaSat-1, respectively. Even though the likelihood that the geographic alignment will occur is small, and the worst case delta T/T is less than 2%, ViaSat has coordinated the operation of this antenna with the satellite operator. ViaSat has coordinated the antenna with all operators of Ka-band systems within +/- 30 degrees of each of the target satellites.

Because width of the main lobe of the antenna increases between the azimuth and elevation axes as the antenna is rotated around the boresight, the alignment of the major axis of the antenna with the GSO must be considered. As the geographic location of the aircraft moves away in longitude from the longitude of the satellite (115.1º WL for ViaSat-1 and 111.1º WL for WildBlue-1 and Anik-F2), the GSO appears skewed with respect to the local horizon of the AES antenna. This skew angle is also affected by the banking of the aircraft while in flight. ViaSat has evaluated the worst case skew angle within the operational service area of the AES antenna and determined it to be less than 50 degrees. The M32 antenna is fully compliant in the main lobe with the 25.138 mask up to a skew angle of 55 degrees. Accordingly, the M32 antenna control unit monitors the skew and bank angle, and will inhibit transmissions if the combination of bank angle and geographic skew are equal to or greater than 55 degrees.

In Figure 3, and in the antenna patterns in Exhibit C, it can also be seen that in the elevation axis there is a narrow line of sidelobes that extends for a few degrees to either side of the elevation axis. The e.i.r.p. density of these sidelobes exceeds the Section 25.138 limit for elevation angles. While the sidelobes do not intersect with the GSO, they do however extend into the region where non-geosynchronous satellites (NGSO) may operate. The only currently identified NGSO satellite system in the Ka-band is the O3b network. ViaSat performed extensive simulations to determine the potential for impact to the O3b network, and following discussions with O3b, has coordinated the operation of the M32 antenna with O3b.